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A5R

(54) Spinal fixation apparatus

(57) A spinal scoliosis fixation implant comprises a plurality of devices 3 which are associated with respective vertebrae 1 and which are interconnected by a single semi-rigid wire 4, or by a cable with abutment ferrules. Each device 3 may comprise a bone screw or hook with a slotted, externally threaded head into which is inserted the wire 4 or cable and also a clamping element which projects slightly from the mouth of the slot, and a nut which is screwed onto the head to press the clamping element onto the wire 4 or cable. The wire 4 or cable can be unclamped, to permit adjustment of the device 3 along the wire 4 or cable, by simply untightening the nut.

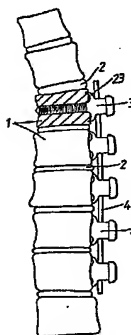


Fig. 1.

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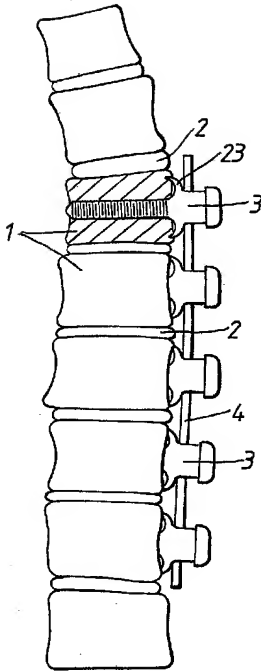


FIG. 1.

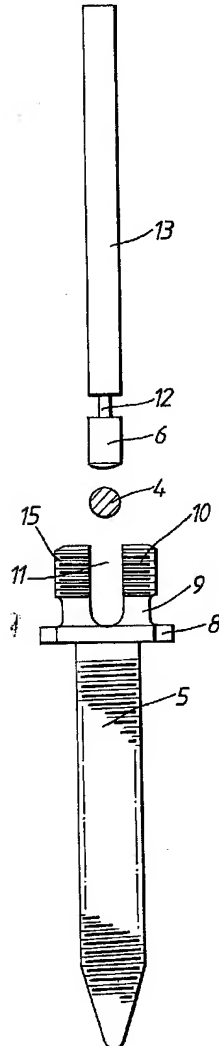
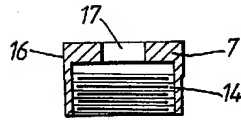


FIG. 2.

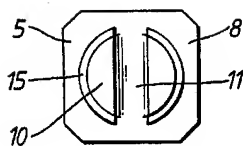


FIG. 3.

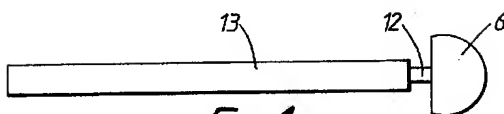


FIG. 4.



FIG. 5.

SPECIFICATION

Improvements in or relating to spinal fixation

5 This invention relates to spinal fixation.

The normal human spine is a segmented column of vertebrae, coupled together by intervertebral joints of two types; viz. anteriorly by intervertebral discs and posteriorly by zygoapophyseal gliding synovial joints.

- 10 Spinal deformity occurs when the normal alignment of the vertebrae is upset or disturbed by altered muscle or nerve function or, more rarely, by abnormal bony structure. Once deformity has been established, secondary changes take place which maintain the abnormality and prevent its return to normal. When the deformity is sufficiently profound, it may be associated with an instability such that the deformity will tend to increase with the axial loading by gravity in spite of the removal of the causative factor.

Under these circumstances it is often necessary to fix together the vertebral levels, after having returned them towards their normal position if safely possible. For this purpose, it is known to provide fixation implants, each of which comprises an elongate member and a plurality of devices for anchoring the elongate member to respective vertebrae. One of these is for use posteriorly and comprises as its elongate member a rigid rod having two hook-like devices connected to respective ends thereof which hook respectively over and under respective vertebrae. With the implant in position on the spine, the devices are adjustable only away from each other. Another known implant, but which is for use anteriorly, comprises a cable and several devices which are fixable in a substantially permanent manner to the cable at intervals therealong. These devices resemble bone screws in order that they may be able to be screwed into respective vertebrae. A third known implant, also for use anteriorly only, comprises a threaded rod, whilst its bone-screw-like devices incorporate rotatable nuts receiving the threaded rod and adjustable therealong by rotation, in order to allow *in situ* adjustment of the vertebral levels towards and away from each other.

According to one aspect of the present invention, there is provided a spinal fixation apparatus, comprising an elongate member, and at least three devices including respective anchoring means whereby said devices are anchored to respective vertebrae and also including respective fixing means whereby said devices are readily releasably fixed to said member at intervals therealong.

According to another aspect of the present invention, there is provided a device for use in spinal fixation, comprising anchoring means whereby said device is anchored to a vertebra, and fixing means whereby said device is readily releasably fixed to an elongate member, said fixing means comprising first and second clamping elements which clamp the elongate member between them, and readily releasable means which urges the clamping elements towards each other.

Owing to the present invention, not only is adjustment of the devices along the elongate member possible in both directions *in situ*, but also the implant can be relatively quickly assembled.

- 70 In order that the invention may be clearly understood and readily carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which:-

Figure 1 shows a lateral elevation of a spinal scoliosis fixation implant *in situ* on a spine, Figure 2 shows an exploded, sectional, plan view of one of at least three identical devices of the implant,

Figure 3 shows an anterior elevation of a bone screw included in the device,

Figure 4 shows a lateral elevation of another element of the device, and

Figure 5 shows a lateral elevation of a modified version of an elongate member of the implant.

Referring to Figure 1, the spine comprises a plurality of vertebrae 1 with discs 2 therebetween. Associated with the respective vertebrae are devices 3 which are interconnected by a single wire 4 which may be about 1/8 inch diameter and which is semi-rigid.

Referring to Figure 2, each device 2 comprises at least three components, one being a bone screw 5, the second being clamping element 6 and the third a cap-form nut 7. The screw 5 has its head consisting of a substantially rectangular flange 8, a plain neck 9, and an externally threaded head 10. A slot 11 extends diametrically through the parts 9 and 10. The wire 4 almost fills that portion of the slot 11 formed in the neck 9. The clamping element 6 is received in that portion of the slot 11 formed in the head 10 and projects slightly out of the mouth of the slot in the assembled condition of the device. The element 6 is connected by a very thin neck 12 to a rod 13 which can be gripped between the thumb and forefinger of the surgeon. The nut 7 is internally screwthreaded at 14 to co-operate with the external screwthreading 15 of the head 10. The nut 7 is moreover formed with an hexagonal external surface 16 and with a central bore 17 through which the rod 13 can be passed, but not the element 6.

For the purpose of implantation, the screws 5 are introduced into the vertebral bodies by an appropriately shaped screwdriver, the slots 11 being finally aligned with one another so that the wire 4 can be introduced into all of them by being simply laid in them. The elements 6 are then introduced into the slots 11 and the nuts 7 screwed down, their top walls coming into contact with the elements 6, until the wire 4 is retained with slightly looseness in the screws 5. Thereupon, the positions of the screws relative to each other along the wire 4 and thus the positions of the vertebral bodies relative to each other along the spine can be adjusted as desired towards or away from each other, as the need for spinal correction determines. The nuts 7 can then be tightened to a predetermined torque, forcing the elements 6 to clamp the wire 4 against the screws 5, to prevent slippage of the screws 5 relative to the wire 4.

The vertebrae are thereby held safely in the desired position and maintained there until an induced arthrodesis has taken place.

If for some reason, subsequent correction of the positions of the screws 5 along the wire 4 is required, then the nuts 7 are readily untightened to allow such adjustment, which is a simple linear sliding movement.

In certain cases where the curvature of the spine is too great to permit use of a semi-rigid wire, in place of the wire 4 there can instead be employed, as shown in Figure 5, a flexible cable 20, which is provided at its respective ends with fixed ferrules 21 each of an external diameter greater than the width of the slots 11. The cable 20 also carries a sliding ferrule 22 also of an external diameter greater than the width of the slot 11.

In implantation, the lower ferrule 21, say, is brought into abutment against the head 10 of the lowest device 2. After clamping the cable 20 to the devices 2, and with the ferrule 22 immediately above the uppermost device 2, the ferrule 22 and the cable 20 are transversely severed, such severing coincidentally clamping the lower piece of the ferrule 22 to the cable 20 to deter subsequent fraying of the upper cable end.

If desired, there can be employed with the screws 5 respective toothed washers 23, as shown in Figure 1, which engage in the bone of the vertebral bodies.

The apparatus shown in Figures 1 to 4 can be used posteriorly, but with devices being identical to that shown in Figures 2 to 4, except that the shanks of the screws 5 are replaced by hooks about the posterior elements of the vertebrae, either the laminae or transverse processes, so that the hook-like devices in this case can be adjusted towards and away from each other along a wire.

40 CLAIMS

1. A spinal fixation apparatus, comprising an elongate member, and at least three devices including respective anchoring means whereby said devices are anchored to respective vertebrae and also including respective fixing means whereby said devices are readily releasably fixed to said member at intervals therealong.

2. An apparatus as claimed in claim 1, wherein said elongate member is a semi-rigid wire.

3. An apparatus as claimed in claim 1, wherein said elongate member is a flexible cable provided with transverse projections arranged to abut the fixing means.

4. An apparatus as claimed in claim 3, wherein said projections comprise ferrules.

5. An apparatus as claimed in any preceding claim, wherein the fixing means of each device comprises a channel-shaped slot for receiving said elongate member and clamping means for clamping the elongate member in the slot.

6. An apparatus as claimed in claim 5, wherein each said clamping means comprises a clamping element which is received in said slot but which projects slightly out of the mouth of the slot in an

assembled condition of said apparatus, and a nut which is screwed onto the relevant anchoring means to press said clamping element against said elongate member.

7. An apparatus as claimed in claim 6, wherein each said anchoring means comprises a bone screw or hook having a head formed with said slot.

8. An apparatus as claimed in claim 6 or 7, wherein each said clamping element is connected by a very thin neck to a rod which extends away from the base of the slot.

9. A device for use in spinal fixation, comprising anchoring means whereby said device is anchored to a vertebrae, and fixing means whereby said device is readily releasably fixed to an elongate member, said fixing means comprising first and second clamping elements which clamp the elongate member between them, and readily releasable means which urges the clamping elements towards each other.

10. A device as claimed in claim 9, wherein the first clamping element comprises a head of a bone screw or hook.

11. A device as claimed in claim 10, wherein said head is formed with a channel-shaped slot for receiving said second clamping element and said elongate member.

12. A device as claimed in claim 11, wherein said second clamping element projects slightly out of the mouth of the slot in an assembled condition of the device, and said readily releasable means comprises a nut screwed onto said head to press said second clamping element against said elongate member.

13. A device as claimed in claim 12, wherein said second clamping element is connected by a very thin neck to a rod which extends away from the base of the slot.

14. A spinal fixation apparatus, substantially as hereinbefore described with reference to Figures 1 to 4, or Figures 1 to 4 as modified by Figure 5, of the accompanying drawings.

15. A device for use in spinal fixation, substantially as hereinbefore described with reference to Figures 2 to 4 of the accompanying drawings.